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Domain formation in model membranes studied by pulsed-field gradient-NMR: The role of lipid polyunsaturation

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Abstract

The effects of increased unsaturation in the sn-2 fatty acyl chain of phosphatidylcholines (PCs) on the lipid lateral diffusion have been investigated by pulsed-field gradient NMR. Macroscopically oriented bilayers containing a monosaturated PC, egg sphingomyelin, and cholesterol (CHOL) have been studied at temperatures between 0°C and 60°C, and the number of double bonds in the PC was one, two, four, or six. For PC bilayers, with and without the incorporation of egg sphingomyelin and CHOL, the lateral diffusion increased with increasing number of double bonds, as a consequence of the increased headgroup area caused by the unsaturation. Addition of CHOL caused a decrease in lipid diffusion due to the condensing effect of CHOL on the headgroup area. Phase separation into large domains of liquid-disordered and liquid-ordered phases were observed in the ternary systems with PCs containing four and six double bonds, as evidenced by the occurrence of two lipid diffusion coefficients. PC bilayers with one or two double bonds appear homogeneous on the length scales probed by the experiment, but the temperature dependence of the diffusion suggests that small domains may be present also in these ternary systems.

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